REMARKS/ARGUMENTS

Upon entry of the instant amendment, claims 25 and 30 will be amended, whereby claims 24-68 will remain pending. Claims 24, 29, 34, 38, 42, 49, 50, 51, 52, 55, 58, 59 and 62 are independent claims.

Entry of this amendment after final rejection is appropriate because the amendment has been made in accordance with the recommendation in the Final Office Action.

Reconsideration and allowance of the application are respectfully requested.

Indication of Allowable Subject Matter

Applicants note that claims 24, 26-29, 31-33, 36-45, 47, 48 and 51-64 are indicated to be allowed. Moreover, claims 25 and 30 are indicated to be allowable if amended to overcome the indefiniteness rejection. Accordingly, at least claims 24-33, 36-45, 47, 48 and 51-64 should presently be allowed. However, for the reasons discussed below, Applicants respectfully submit that each of the pending claims is in condition for allowance, and an early mailing of the Notices of Allowance and Allowability is respectfully requested.

Response To Rejection Under 35 U.S.C. 112, Second Paragraph

In response to the rejection of claims 25 and 30 under 35 U.S.C. 112, second paragraph, as being indefinite, Applicants respectfully submit the following.

By the present amendment, claims 25 and 30 have been amended to delete "further". In this regard, Applicants respectfully submit that the claims are clear prior to the present amendment, but are making this amendment to even further clarify their language.

Accordingly, the 35 U.S.C. 112, second paragraph, rejection should be withdrawn, and no estoppel should be associated with these amendments.

Response To Rejections Based Upon Prior Art

Rejection of claims 34, 35 , 49, 50 and 65-68 under 35 U.S.C. 103(a) as being unpatentable over EP 294,208 (hereinafter "EP '208").

Initially, prior to discussing the merits of the rejection, Applicants note that U.S. Patent Nos. 4,954,462 and 5,185,299 (which are cited in Applicants' Information Disclosure Statement) are family members of EP '208

In contrast to Applicants' disclosed and claimed subject matter, <u>EP '208 is directed to the disclosure of the microstructure of the powders that can be formed, and not to the powders themselves</u>. The parameters set forth in EP '208 relate to the grains, and <u>not to the size of powders</u>. EP '208 does not appear to provide any teaching or suggestion of powders according to Applicants' disclosed and claimed invention. The powders disclosed in EP '208 appear to be powders formed including grains, and the size of the grains are disclosed in EP '208. The powders in EP '208 should have sizes greater than the grains, and therefore would have sizes of particles that are much larger than those that are recited in Applicants' claims. For example, attention is directed to Example 2 of EP '208 which discloses specimens of beads having a diameter of about 150 micrometers, with the surface of the beads consisting of 0.1-0.4 micrometer crystallites with tan average grain size of about 0.3 micrometer.

More attention is directed to EP '208 at page 3, lines 57-58, where average crystallite size is disclosed, and page 10, last three lines, wherein fibers were found to be composed of 0.2-0.5 micrometer alpha alumina grains with an average grain size of about 0.25 micrometers.

Accordingly, EP '208 is directed to materials having a certain microstructure, and this is not the particles recited in Applicants' claims. In particular, the "articles" disclosed by EP '208 are fired materials with an inner microstructure. These articles do not comprise powders as recited by Applicants. In other words, for example, Applicants' claim 34 is directed to nanocorundum powders comprising a close particle size distribution in nanometer range, comprising a narrow width of size distribution of isometrically formed particles $D_{84} < 150$ nm, less than 0.05% by weight chlorine, at least 60% α-aluminum oxide, and the powders are redispersible. In contrast, EP '208 is directed to grain size of a microstructure which is not present in Applicants' claims 34 and 35. This is different from Applicants' recited nanocorundum powders which are individual powder particles.

Still further, Applicants' claim 49 is directed to dense sinter corundum layers consisting essentially of Al_2O_3 on a substrate produced by a process for producing redispersible nanocorundum with an average particle size $D_{50} < 100$ nm with addition of nuclei that promote transformation to corundum in subsequent annealing, which process comprises:

(a) dissolving in a liquid medium or processing in a liquid medium to a sol, as starting materials, chlorine-free inorganic precursors;

(b) hydrolyzing the solution or the sol of (a) through the addition of a base in a mole ratio of base:precursor of 1 to 3;

(c) aging the hydrolyzed solution or sol of (b) at temperatures between 60 and 98°C for 1 to 72 hours;

(d) applying the aged hydrolyzed solution or sol of (c) to a substrate;

(e) subsequently drying the applied aged solution or sol of (d) followed by calcination at temperatures between 350 and 650°C for converting hydrolyzed precursor into a semiamorphous intermediate phase and ultimately into transitional aluminum oxides; and

(f) performing annealing by increasing temperature to ≤ 950°C for converting product of (e) into corundum phase,

wherein the substrate is composed of a different material from the corundum layers, and in which through sintering at a temperature of ≤ 1250°C there is an average grain size of ≤ 0.5 μm.

Applicants' claim 50 is directed to dense sinter corundum layers consisting essentially of Al_2O_3 on a substrate produced by a process for the production of sintered porous or dense corundum layers on a substrate by a process for producing redispersible nanocorundum with an average particle size $D_{50} < 100$ nm with addition of nuclei that promote transformation to corundum in subsequent annealing, which process comprises:

(a) dissolving in a liquid medium or processing in a liquid medium to a sol, as starting materials, organic precursors;

(b) hydrolyzing either (i) with excess water through addition of the precursor solution or the precursor sol of (a) to water at a mole ratio of water:precursor $>$ 3, and with addition of an acid that leads to pH = 3-5, or (ii) through addition of an amount of water restricted to a mole ratio of water:precursor $\leq$ 3 to the precursor solution or precursor sol of (a) that are to be mixed with complex-forming ligands;

(c) aging the hydrolyzed solution or sol of (b) at temperatures of $\leq$ 50°C within 5 hours, and subsequently aging at temperatures of 80 to 98°C within 1 to 24 hours;

(d) applying the aged hydrolyzed solution or sol of (c) to a substrate;

(e) subsequently drying the applied aged solution or sol of (d) followed by calcination at temperatures between 350 and 650°C for converting the hydrolyzed precursor into a semiamorphous intermediate phase and then to transitional aluminum oxides; and

(f) performing annealing by increasing temperature to $\leq$950°C for converting product of (e) into corundum phase,

wherein the substrate is composed of a different material from the corundum layers, and in which through sintering at a temperature of $\leq$ 1250°C there is an average grain size of $\leq$ 0.5 μm.

Still further, EP '208 does not teach or suggest, as recited in Applicants' claim 65, nanocorundum powder produced according to the process recited in claim 24 comprising a median value of particle size distribution $D_{50} < 100$ nm.

Still further, EP '208 does not teach or suggest, as recited in Applicants' claim 66, nanocorundum powder produced according to the process recited in claim 29 comprising a median value of particle size distribution $D_{50} < 100$ nm.

Still further, EP '208 does not teach or suggest, as recited in Applicants' claim 67, nanocorundum powders produced according to the process recited in claim 24 comprising a close particle size distribution in nanometer range, comprising a narrow width of size distribution of isometrically formed particles $D_{84} < 150$ nm, less than 0.05% by weight chlorine, at least 60% α-aluminum oxide, and the powders are redispersible.

Still further, EP '208 does not teach or suggest, as recited in Applicants' claim 68, nanocorundum powders produced according to the process recited in claim 29 comprising a close particle size distribution in nanometer range, comprising a narrow width of size distribution of isometrically formed particles $D_{84} < 150$ nm, less than 0.05% by weight chlorine, at least 60% α-aluminum oxide, and the powders are redispersible.

Moreover, with respect to claims 49 and 50, Applicants note that these claims are directed to products which consist essentially of Al_2O_3. Moreover, Applicants note that the specification, at page 10, beginning at line 23 defines that, "The term corundum thereby characterizes compositions of more than 98% Al_2O_3 for powder and sintered ceramic..." Accordingly, the corundum of Applicants' disclosed and claimed invention includes compositions having more than 98% Al_2O_3,

In contrast to Applicants' disclosed and claimed invention in claims 49 and 50, EP '208 discloses the addition of suitable quantities, for example, 0.1 to 7.0 weight percent iron equivalence, preferably 0.3 to 1.5 weight percent iron equivalence, of at least one colloidal-polymeric hydrous iron complex to an alumina precursor such as a basic aluminum salt

solution. Accordingly, EP '208 does not teach or suggest Applicants' disclosed and claimed invention as recited in claims 49 and 50.

For the reasons set forth above, EP '208 does not teach or suggest Applicants' disclosed and claimed invention, whereby this ground of rejection should be withdrawn.

Rejection of claims 34, 35 and 65-68 under 35 U.S.C. 103(a) as being unpatentable over EP 554,908 (hereinafter "EP '908")

Initially, prior to discussing the merits of the rejection, Applicants note that U.S. Patent No. 6,048,577 (which is cited in Applicants' Information Disclosure Statement) is a family member of EP '908, This family member is being specifically referenced in this response to direct the Examiner's attention to the TEM photos that are illustrated therein which are clearer than those included in EP '908. Thus, in the remarks below, attention will be directed to the clearer photographs in the U.S. patent family member.

Applicants once again note that EP '908 is directed to nano-sized powders of alpha alumina obtained from a boehmite gel doped with a barrier-forming material such as silica, which is then dried, fired and comminuted to powder form.

Thus, the process disclosed by EP '908 starts with boehmite. In contrast, and as discussed throughout Applicants' discussion of the prior art in the background of their specification, there are a number of disadvantages resulting from the use of boehmite. Applicants' advantageous powders are a result of a process that avoids the use or even intermediate formation of boehmite.

Moreover, EP '908 discloses in Example 1 that nanocorundum powder could be obtained from a coarser commercial alumina powder by simple milling.

Regarding Applicants' product claims 34 and 35, the different processes disclosed by EP '908 as compared to that of Applicants' invention provides a different product that does not teach nor suggest Applicants' product. Moreover, while EP '908 provides particle data using techniques such as from a measured specific surface (BET) or from electron microscopic images. However, this data is not as accurate as the measuring techniques disclosed by Applicants, such as the Zeta-Sizer disclosed in Applicants' Example 1.

Basically EP '908 does not perform a measurement of particle sizes, but obtains data from visual observation in Figs. 1 and 4. These figures may display an individual particle structure, such as disclosed at page 5, line 46; however, this structure is not an indication of obtained and observed individual particles but of agglomerated particles.

Applicants enclose herewith as Fig. 1 a Scanning Electron Microscope (SEM) photograph and as Fig. 2 a Transmission Electron Microscope (TEM) of particles of the type recited in Applicants' claims in order to assist the Examiner's understanding of such non-agglomerated redispersible particles as disclosed and claimed by Applicants as compared to agglomerated particles as disclosed and illustrated by EP '908. EP '908 does not teach or suggest redispersible powders as disclosed and claimed by Applicants. In fact, Figs. 1 and 4 of EP '908 and U.S. Patent No. 6,048,577 give clear illustration that such particles are not redispersible.

SEM and TEM photographs are presented herein as evidence that either SEM and TEM photographs illustrate differences between Applicants' redispersible particles and particles as disclosed by EP '908.

As noted above, the differences between the particles disclosed and claimed by Applicants is attributable to the differences in synthesis with the particles disclosed by EP '908 being unable to provide a redispersible nanopowder as recited by Applicants

. Expanding upon the above, the powder of EP '908 is synthesized, such as disclosed at page 3, beginning at line 30, by dispersing in a boehmite gel a material that forms a barrier around the boehmite particles, at a temperature below that at which boehmite converts to alpha alumina, the material being incorporated in an amount sufficient to inhibit particle size growth after formation of alpha alumina from the boehmite, then drying and firing the gel at a temperature to convert at least the major proportion of the alumina to the alpha phase in the form of loose aggregates of ultimate particles with sizes from about 20 to about 50 nanometers. The barrier material is disclosed to be believed to form a very thin coating around the particles of boehmite in the gel which inhibits migration of alumina across the particle boundary and thus prevents, or at least significantly inhibits, growth of the particle as it is converted to the alpha phase. It is disclosed that the result is therefore the formation of alpha alumina particles with sizes of the order of those in the originating boehmite gel, and that the barrier material is conveniently a glass.

From the above, it is seen that the particles of EP '908 contain significant amounts of glass which is different from the nanocorundum powder disclosed and claimed by Applicants which as

discussed above is defined in the specification as including compositions having more than 98% Al_2O_3.

Still further, Applicants submit herewith the following documents to further assist the Examiner's understanding of the differences between EP '908 and Applicants' disclosed and claimed invention, as well as the benefits associated with Applicants' invention[1]:

(1) Krell et al., NanoStructural Material, Vol. 11, No. 8, pp. 1141-1153 (1999) – (Krell 1).

(2) Ma et al., Key Engineering Materials, Vol.. 206-213, Part 1, 43-46, (2001)

(3) Li et al., Acta mater, 48 (2000) 3103-3112.

(4) Krell et al., J. Am. Ceram. Soc., 86(2) 241 -246 (2003) – (Krell 2).

In particular, attention is directed Krell 1 in Fig. 1b which demonstrates that because of their redispersibility, the nanostructure of the individual particles cannot only be shown by electron microscopy, but is qualitatively measured with a D50-valueof the distributions at , e.g., 40 or 50 nm. No such measurement is possible for the powders disclosed by EP '908.

Moreover, specific attention is directed to Ma et al. Fig. 6 which gives an example of extremely fine-grained and highly dense microstructures that were sintered from Applicants' disclosed nanocorundum powders. Moreover, attention is directed to Figs. 3 and 4 demonstrating SEM and TEM of Applicants' powders.

1 The documents are being submitted in accordance with MPEP 609(C)(3) as part of Applicants' reply to the Office Action in support of an argument so that the requirements of 37 C.F.R. 1.97 and 1.98 need not be met, and the information is being submitted as part of the record with the reply for the Examiner's consideration with Applicants' reply.

Still further, Li et al., shows and explains why previously known nanopowders, such as disclosed by EP '908, cannot provide such fine-grained and dense sintered products. The reason is locally differential sintering caused by agglomeration, as can be seen in Fig. 14, even for a powder with "soft" agglomerates gives a sintered microstructure with visible porosity.

It is therefore clear that the agglomeration evidenced by the figures in EP '908 is detrimental to the production of fine-grained and highly dense products independent of the degree (strength) of agglomeration. Similarly, porous bodies, such as filtration membranes, are obtained from Appliccants' redispersible nanocorundum with a very homogeneous microstructure and extremely narrow size distribution of pores, as see, for example, Krell 2, which is impossible when starting with an agglomerated raw powder like that of EP '908.

Therefore, this ground of rejection is without appropriate basis should be withdrawn.

Rejection of claim 46 under 35 U.S.C. 103(a) as being unpatentable over Katoh, U.S. Patent No. 5,925,592

In response to the rejection of claim 46 as being obvious over Katoh, Applicants respectfully submit that claim 46 is directed to Al_2O_3 sintered product comprising a sintered mass of the nanocorundum produced according to claim 28 and which consists essentially of Al_2O_3, wherein through annealing at 650 to 1250°C, there is a phase composition of more than 80% corundum and an average pore size of 10 - 100 nm with a porosity of $\geq$ 30% by volume.

Thus, amongst other features recited in Applicants' claim 46, the claims includes a phase composition of more than 80% corundum and an average pore size of 10 - 100 nm with a porosity

of ≥ 30% by volume. In contrast, Katoh does not appear to disclose a porosity of ≥ 30% by volume as recited in claim 46. Moreover, Katoh' Example 1 discloses the use of a temperature of 600°C. Accordingly, this example does should not contain any corundum which cannot be formed at such a low temperature.

In view of the above, this ground of rejection is without sufficient basis, and should be withdrawn.

CONCLUSION

In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw the rejection of record, and allow all the pending claims.

Allowance of the application is requested, with an early mailing of the Notices of Allowance and Allowability.

If the Examiner has any questions or wish to further discuss this application, the Examiner is invited to telephone the undersigned at the below-listed telephone number.

Respectfully submitted,
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